

1 **Food Resources**

Chapter 13

2 **How Is Food Produced?**

- Sources of food
- Primary plants:
wheat, corn, and rice
- Primary animals:
beef, pork, and chicken

3 **The Plants and Animals That Feed the World**

- Grains: wheat, rice, and corn (annuals)
- Meats: beef, pork, and chicken
- Also, eggs, milk, cheese, yogurt....(other products vegans don't eat, all these are animal products)
- Fish/shellfish are 6% of protein consumed

4 **Major Types of Agriculture**

- Traditional subsistence
- Traditional intensive
- Plantation
- Industrialized (high-input)

5 **Traditional Subsistence**

- Mostly human labor & draft animals
- Low-input agriculture
- Examples: shifting cultivation in tropical forests and nomadic livestock herding
- Use interplanting (several crops : 1 plot)
- Polyvarietal cultivation (1 crop-++variety)
- Intercropping: 2-3 crops : 1 plot
- Agroforestry (alley cropping): crops + trees : 1 plot
- Polyculture: complex intercropping

6 **Polyculture**

- Less need for fertilizer and water because roots different depths
- Erosion protection-soil covered year round
- Little need insecticides due to multiple habitats for natural predators
- Little need for herbicides weeds have trouble competing
- Insurance against weather events due to diversity of crops

7 **Traditional Intensive Agriculture**

- Increase input of human and draft labor

- Fertilizer and water added
- Higher yield / acre compared to subsistence
- Sell production beyond needs for income

8 **Industrialized Agriculture**

- Large amounts of fossil fuel energy used
- Irrigation, commercial fertilizers, pesticides
- Produce huge quantities of single crop or livestock animals for sale
- Used mostly in developed countries on about 25% of all cropland

9 **Plantation Agriculture**

- Form of industrialized agriculture
- Occurs in tropical developing countries
- Cash crops on monoculture plantations

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13 **Croplands**

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- **Ecological Services**
- Help maintain water flow & infiltration
- Provide partial erosion protection
- Build soil organic matter
- Store atmospheric C
- Provide wildlife habitat

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- **Economic Services**
- Food crops
- Fiber crops
- Crop genetic resources
- jobs

14 **Producing Food by Green-Revolution Techniques**

- High-input monoculture
- **Selectively bred or genetically-engineered crops**
- High inputs of fertilizer
- Extensive use of pesticides

- High inputs of water
- **Increased intensity and frequency of cropping (multiple cropping)**
- **1950-1970 1st in developed countries**

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17 **US Agriculture**

- Highly productive: 0.3% world labor force
- Produce 17% of world grain
- 50% of world grain export
- US residents spend 12% income on food
- Japan: 18%;
- developing countries: 40-70%
- Uses FOSSIL FUEL: 10x fossil fuel as total food energy on our table

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19 **Food Production**

- Rapidly increasing (more grain)
- Prices decreasing (compared to 1957)
- Shortages in developing countries (more people than food produced)
- Since 1985, grain production leveled due to < incentive & soil productivity
- Approaching limits on meat production

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22 **Nutrition**

- Undernutrition: cannot buy or grow enough food for basic energy needs
- Chronically undernourished consume 100-400 Kcal less than need, can't do much work; children mr, stunt growth, susceptible to infectious disease
- Malnutrition: deficiencies of protein & key nutrients
- 2 diseases: marasmus (low Kcal & mal)
- Kwashiorkor: no protein ages 1-3 yr

23 **How prevalent is poor nutrition?**

- Average daily food intake/person up even with population growth
- Chronically undernourished down to 826 million in 2000, mostly in developing countries
- 1:6 people in developing countries is hungry
- 10 million people a year die from hunger or hunger related problems

24 **Micronutrient Deficiencies**

- Vitamin A biggest problem: leads to blindness, premature death due to infectious diseases
- Betacarotene major source: golden rice is genetically altered rice to increase betacarotene
- Need to eat 20 lbs rice/ day, can't convert without enzymes; need to be healthy to have enzymes

25 **Iron and Iodine Deficiencies**

- Iron: anemia, fatigue, low resistance to infection, more women die in childbirth (bleeding), affects learning
- Iron found in leafy greens, whole grains and meats
- Iodine found in seafood and crops grown in I rich soils
- Affects metabolism, growth, mr, goiter

26 **Overnutrition**

- Problem of developed countries
- Preventable
- Lower life expectance, greater susceptibility to disease, lower productivity and life quality

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28 **Distribution is Problem for the hungry**

- Produce enough for everyone to have subsistence diet grains
- Arable soil distribution uneven
- Climate varies
- Political and economic power unevenly distributed
- Average per capita income unevenly distributed
- POVERTY

29 **Environmental Effects of Food Production**

- **Biodiversity loss**
- **Soil: erosion, desertification**
- **Air pollution**
- **Water: deficits and droughts**
- **Human health**

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32 **Effects of Global Warming**

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- Advantages
- Increased crop yields
 - Increased precipitation in some dry areas
 - Longer growing seasons in cool areas
 - More warm H2O fish
 - Expanded growing area

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- Disadvantages
- Lower crop yields
 - Decreased precipitation
 - Shorter growing seasons
 - Increased pest pop

- Loss wetlands & fertile coastal land
- Change in fish distribution

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34 **Increasing World Crop Production**

- Crossbreeding and artificial selection
- Genetic engineering (gene splicing)
- Genetically modified organisms (GMOs)
- Continued Green Revolution techniques
- Introducing new foods
- Working more land

35 **Genetically Improved Crop**

- Most increases in future food production will come from genetically improved strains
- Crossbreeding: artificial selection
- Genetic engineering: recombinant genetic techniques (gene splicing)

36 **Crossbreeding**

- Select desired traits in same species (or in plants, similar species)
- Series of cross breedings to obtain organism that possesses most of the qualities
- Takes several generations (years)
- Pests and diseases evolve/adapt to new variety

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39 **Genetic Engineering**

- Transgenomics is recombinant genetics
- Expensive
- Length of piece inserted has limitations due to techniques, original genome size, or length of vector's genome
- Controversial
- Advanced tissue culture techniques

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43 **Frankenfood**

- ? Harm to human health and ecosystems
- Can't recall GMO
- Need more field research
- More research to determine safety
- Stricter regulation of technology
- Mandatory labeling of products as GMOs
- Misuse: pathogens, terminator genes

44 **GMF**

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- Advantages
- Less fertilizer
- Less water
- Resistance to insects
- Resistance to disease
- Grow in saline soils
- Better flavor/less spoil
- Tolerate more pesticides

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- Disadvantages
- Irreversible
- Toxins
- Allergens
- Lower nutrition
- >evol pests
- >evol weeds
- Lower genetic variety

45 **Feeding 9.3 billion people**

- Green rev. feed 9.3 billion?
- Recombinant genetics looks promising
- Transform areas currently trad inten/industrial to green rev techniques
- May/won't work in arid/semiarid conditions
- Large capital required

46 **Can the green revolution continue to expand to feed 9.3 billion in 2050?**

What are other ways to increase food production/availability?

47 **Irrigation?**

- More land is being irrigated
- Water is pumped faster than the aquifer recharges
- Inefficient irrigation methods
- Larger cities have increased demand for water
- Irrigation is expensive for farmers

- Global warming will alter rain patterns

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49 **Is there more land to cultivate?**

- Some cleared land is not truly arable
- Some land is too dry and irrigation costs outweigh the benefits of cultivation
- Converting land from range purposes to cultivation is not efficient
- Converting land that has parasites is not efficient
- Converting land reduces biodiversity

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52 **Producing More Meat**

- Rangeland
- Pasture
- Efficiency
- Adaptations of rangeland plants
- Range condition and management
- Environmental consequences

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56 **Industrialized Meat Production**

- o Grow pastures/finish feedlots
- o Concentrates pollution problems
- o Uses much of world's grain supply
- o Uses some of world's fish supply
- o Increased use of fossil fuel
- o Increases spread of infectious diseases
- o Anthrax, mad cow

57 **Overgrazing/undergrazing**

- Over: reduces productivity, contributes to erosion, compacts soil, leads to invasion of weeds, weedy shrubs, desertification
- Under: some areas over grazed while others are not utilized

58 **Rangeland Management**

- Balance number, type, duration, and distribution of livestock

- Deferred grazing
- Rangeland restoration

59 **Rangeland Use**

- Not even distributions (need to have source of water)
- Climatic conditions vary
- Soil and indigenous plants vary, hard to estimate carrying capacity
- Different species graze at different intensities and different plants

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65 **Catching and Raising More Fish**

- Fisheries: concentrations of aquatic species suitable for harvest
- Fishing methods
- Sustainable yield
- Overfishing
- Commercial extinction
- Aquaculture
- Fish farming and ranching

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67 **Fishing Methods**

- Trawl
- Purse seine
- Longlining
- Drift net fishing
- Aquaculture: ponds and cages
- Freshwater fisheries

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69 **Fish and Marine Sustainability**

- Until 1980's increased catch
- Pop grows; fish per capita is decreasing
- BYCATCH
- Overfishing
- Pollution

- Habitat destruction
- 14 commercial fish in US waters commercially extinct (107 of 127 species in danger)

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73 **Aquaculture**

- Fish farming: cultivating fish in controlled environment
- Fish ranching: stocking – hold anadromous species in cages for few years; release and catch as adults
- Fish polyculture-feed at different trophic levels

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77 **Agricultural Policy and Food Aid**

- Artificially low prices
- Subsidies
- Elimination of price controls
- Food aid

78 **Objectives**

- 1) List 4 major types of agriculture. Compare the energy sources, environmental impacts, yields, and sustainability of traditional and industrial agriculture.
- 2) Evaluate the green revolution. What were its successes? What were its failures? Summarize the benefits and problems of livestock production over the history of agriculture.

79 **Objectives**

3. Define interplanting and explain its advantages. List and briefly describe 4 types of interplanting commonly used by traditional farmers.
4. Summarize the state of global food production. Define malnutrition and undernutrition, and overnutrition. Indicate how many people on Earth suffer from these problems and where these problems are most likely to occur. List 6 steps proposed by UNICEF to deal with malnutrition and undernutrition. Describe a strategy to reduce overnutrition.

80 **Objectives**

5. Discuss the use of genetic engineering techniques to improve the human food supply.
6. Summarize environmental impacts from agriculture.
7. Summarize food distribution problems. Describe the possibilities of increasing world food production by increasing crop yields, cultivating more land, and using unconventional foods and perennial crops.

81 **Objectives**

8. Discuss problems associated with the production of livestock on rangeland.
9. Describe trends in the world fish catch since 1950. Assess the potential for increasing the annual fish catch and use of aquaculture. Distinguish between fish farming and fish ranching.
10. Assess the pros and cons of agricultural subsidies and international food relief. Describe strategies that you feel would be most sustainable.

82 **Objectives**

11. Define sustainable agriculture. Summarize how the United States could move toward creating a more sustainable agricultural system.